

**Vermont Agency of Transportation**  
**Statewide Small Culvert Inventory (SCI)**  
**Field Manual**

**PHASE II Re-Inspection**



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## **Foreword:**

The Agency is responsible for the maintenance of a large, complex drainage system composed of culverts, drop inlets, and access holes. Deterioration of these hidden assets poses potential safety hazards to the traveling public through roadway sinkholes and side slope instability caused by drainage erosion. In addition to the immediate safety concerns, lack of knowledge regarding the location and condition of small culverts also increases the risk to a growing economic burden for the state.

Traditionally, VTrans has maintained a well-developed program as part of the National Bridge Inventory System (NBIS) to address culverts 72" or greater in dimension. The Small Culvert Inventory (SCI) was designed to complement that program. The SCI is intended to locate and catalog all state-owned culverts with a measured internal dimension that is less than or equal to 72" in diameter. The inventory records culvert location and assesses them for composition, structural condition, and local site conditions. It further provides the framework for continued monitoring and condition assessments projections that allow the Agency to effectively prioritize maintenance, repairs, and replacements.

Currently, the Agency has collected the initial state-wide inventory of culvert data. The focus has now shifted from collection of new data to updating and improving existing data (Phase II). The focus of this phase is to implement a plan utilizing modern Mobile GIS / GNSS technology to conduct Statewide Small Culvert Re-inspections by local District staff following the protocol to reinspect 20% of the entire inventory every year.

## **Data Collection:**

Like the initial inspection, re-inspection teams should consist of two members. A typical team will consist of an inspector, and an additional technician. The inspector is responsible for running and maintaining the Mobile GPS/GNSS equipment (iPad, Tablet, Smart Phone) and all data collection. Additional personnel are responsible for clearing brush, trees, debris, and sediment from the inlet and outlet areas of the culverts. They also assist with traffic control as well as clearing and opening drop inlet grates where necessary.

Prior to a day's field work the inspector is responsible for deciding all scheduling, weather cancellations, daily work plans, and various general issues that develop during the work day. Where work area reception is poor or nil, caching of maps should be done prior to entering the field. The inspector is also responsible for ensuring the acquisition of the necessary resources for the day's field work, including the following:

### **Essential Equipment:**

- Data Collection Equipment (iPad)
- Flashlight
- Shovel
- Metric/English Tape
- Traffic Control Sign Package

### **Optional Equipment:**

- Metal detector
- Air horn
- Brush cutters
- Pry Bar
- Grade stakes
- Spray paint
- Sledge hammer

Upon arriving at the work site location established the previous working day, the inspection team should establish a work area. The inspector sets up sign packages with the help of the district personnel. Each member of the team is responsible for their own Personal Protective Equipment (PPE), rain gear, and tick/mosquito repellent. A fully-stocked first aid kit should always be in the vehicle

To begin field work, the mobile device should be turned on and the ESRI Collector Application opened. A two-person inspection team should have one person performing the inspection, recording the condition and spatial information. The other personnel works to clear overgrowth, sediment, and debris while maintaining situational awareness of hazards. This is especially true if the inspector's attention is compromised due to inspection operations.

Unlike conducting initial inventory with the Trimble GPS Device, the PID (Pipe Identification) number is auto generated through an overnight process when new culvert features or inspections are created within the ESRI Collector Application on a mobile device. Therefore, it is not necessary for field staff to populate PID values for new features collected in the field using the ESRI Collector application.

## Daily Operations:

### The inventory should operate as follows:

- The inspector should use their iPad Collector App in transit while the additional personnel is driving and on the ground to help find the locations of the culvert inlets and outlets. Information such as pipe length, treatment, and orientation to the road can be used to establish culvert locations.
- The additional personnel should clear brush and trees that may inhibit inspection of culverts, or sod that may inhibit viewing of Drop Inlets (DIs). Drop inlet grates may be opened for inspection when necessary and practical, but it is not mandatory.
- Once cleared, the inspector can perform the culvert assessment more safely and efficiently.
- A photo of each inlet and outlet and barrel should be taken at the conclusion of each inspection. At least one photo should be taken for each drop inlet or access hole. Additional photos should be added to record other observations like sinkholes, road settling, or erosion.
- **IMPORTANT:** When multiple photos are taken for a single feature, it is important that data collectors rename attachments from their default values (ex. "photo1") to something more descriptive like "Inlet", "Outlet", "Sinkhole at outlet". Without attachment names it is difficult to discern an inlet photo from an outlet photo when viewing data in web mapping. To rename an attachment in ESRI Collector application, click on the attachment after taking the photo, and select "Rename". Be sure to rename any attachments before hitting "Done" in the attachments window.

At the end of the workday, the inspector is responsible for syncing any offline collected features or inspections from their downloaded map and charging the mobile device. Maps needed for future offline collection should also be cached at this time. Following end of day protocol will help reduce or prevent issues from arising during the following day of inspections.

## Safety Considerations:

The SCI Phase II will mobilize inspection teams to different locations within the State of Vermont. The team may encounter numerous hazards such as steep embankments, heavy traffic, unstable slopes, and flowing water. The intent is to obtain an updated condition assessment of all small culverts; however, the **inspection team should not compromise their safety.**

Please follow the following safety precautions:

- Park your vehicle off the road and clear of the white line defining the shoulder to ensure it does not become a hazard. If you are using a private vehicle, be sure to display your AOT placard. Make sure that your vehicle is equipped with a visible amber light and that the light is activated. If you are using a crossover on a highway, you **MUST** use an amber light and follow the procedures in the Safety Manual for using crossovers.
- Once you leave the vehicle, you are required to wear the standard AOT vest and orange ball cap, as well as non-standardized trousers and approved safety shoes.
- Be aware of noxious plants in the Right of Way (ROW). Poison ivy and wild parsnip are prevalent residents along our highways. If you don't know how to recognize them in the field, ask someone who does or refer to your field inspection manual.
- Culverts that are less than 60 inches in diameter and culverts where the inlet or outlet do no exit at grade, are considered permit required confined spaces and cannot be entered without following permit required confined space procedures. Do not physically enter any culverts without a permit, proper training and equipment.

## Ticks:

- **Caution:** The tick population is escalating and gradually expanding in range. Consequently, this raises the risk of contracting any number of harmful bacteria or viruses through tick bites, most notably Lyme Disease.
- All field staff should conduct spot checks of themselves one to two times a day. Ideally, a thorough tick check should be performed once each day. Thorough tick checks require removal of all clothes in a private room away from the public or co-workers.
- Proceed to check all areas of your body for ticks. Ticks hide along the edge of the hairline, in joints, and moist/ warm areas of the human body. A proper screening for ticks includes all skin creases or crevasses of the body. Checking of the scalp is also required. Very slowly run your hand through your hair and feel for any bumps that should not be there. A large mirror will assist with the tick checking process.

- At the end of the day clothing used in the field should be put into a dryer on high heat for at least 15 minutes. Ticks require moisture to live, the dry environment of the Dryer cycle will quickly kill them. Clothes should then be washed to ensure full cleansing of contaminated clothing.
- Deterrence of ticks can be accomplished in a myriad of ways. Vigilance during the day will help to mitigate the tick threat. Be attentive to crawling sensations on your skin as it may be a tick. Wearing light colored clothing will allow field staff to better spot ticks as well as staying cooler during hot weather. It is also advised to tuck pant legs into socks as to mitigate tick infiltration into your clothing. It should be noted that ticks always crawl up. Given this fact, be aware of sensations on the lower extreme of your body earlier in the day. Towards the end of the day ticks will be more likely to be located towards the upper areas of the body.
- Deterrence can be accomplished through spray repellent applied to clothes in the morning before entering the field, and occasionally throughout the day. These repellents can consist of natural or chemical ingredients. To select the right product, see the label of the spray for more details. The label will describe which type of insects the repellent is effective in deterring.

**DISCLAIMER:** VTrans does not require, nor does it ask employees to apply permethrin for tick prevention. Any VTrans employee that uses permethrin must do so willingly and must follow all instructions located on the used product completely, taking all necessary precautionary measures. Notify your supervisor before use of permethrin.

- Another method of tick prevention is the treatment of clothes before entering the field. Permethrin is a treatment applied to clothes that will enter its fibers, and it is shown to be an effective tick deterrent. Permethrin affects the nervous system of insects that eat it, causing them to have muscle spasms and die. Permethrin **MUST be applied properly to effectively protect the health of the person(s) involved.** While permethrin is not fatal to humans it can cause health problems if it is ingested, absorbed through skin, or inhaled during the application process. **Permethrin is toxic to dogs and other animals and EXTREMELY TOXIC/ FATAL to cats.** Permethrin treated clothes cannot be washed with clothes that have not been treated with permethrin. Permethrin should only be applied to the outer layer of clothing, and should never be applied to under garments. For more information on the permethrin application processes, deterrence capabilities, and safety and health concerns see the links below.  
<http://npic.orst.edu/factsheets/PermGen.html>  
<https://www.epa.gov/insect-repellents/repellent-treated-clothing>

**IF YOU HAVE ANY QUESTIONS, CONCERNS, PLEASE ASK YOUR SUPERVISOR OR THE AOT SAFETY OFFICE!**



## **Identifying Parts of a Culvert for inspection purposes:**

During the inspection process the inspector is responsible for assessing three parts of a culvert: the inlet, outlet, and barrel. The three parts are defined by specific definitions based on location. An inlet or outlet is represented by the respective end of the culvert. The barrel of a lateral, slope, or Private culvert is the section of pipe that occurs usually after the first section of the pipe terminals.

The definition becomes more complicated if the culvert is a cross pipe. When a culvert goes under a state-maintained road the definition of the inlet and outlet areas will change. In this case the inlet and the outlet of a pipe are shown to end where the edge of the road pavement begins to overlap the culvert. The section that is directly covered by the overhead road will be defined as the barrel of the culvert.

Thus, the inspection of the inlet and outlet of the culvert should extend through the barrel of the culvert up to where the edge of the culvert begins to go under the road. While the remainder of the pipe that runs under the road will be the barrel of the culvert. This is only applicable to culverts that cross under a section of state-maintained road.

## SCI PHASE II DATA DICTIONARY Notes:

This Data Dictionary makes up the attribute table within the Collector Application used to record information about each small culvert. Many of the small culvert barrels will be difficult or impossible to inspect due to the lack of access. The data dictionary shown below is designed to replicate the fields that will be evaluated during the inspection process. Some fields that are present in the final version of the data are not included in the data dictionary shown below because they are not assessed in the inspection process. There are additional data dictionaries for drop inlets and access holes.

**Field key words:** Within the data dictionary each field may be accompanied by one of the following keywords, their meanings are detailed below.

*(Editable)* -An inspector may edit data in this field; editable fields contain data that is important to the inspection of a culvert. The data in this field is often determined by the inspector during a culvert inspection.

*(Non-editable)* -An inspector is unable to edit the data contained within this field. Data in these fields are often reference data that may be used to facilitate a smooth culvert inspection.

*(Non-Editable, Automated)* -An inspector is unable to edit data in this field, and the data is updated on a nightly, or routine basis through background overnight geoprocessing.

## **INLET OBSERVATIONS AND ASSESSMENTS:**

**Delete Record** - Allows the user to delete an accidentally added culvert. Using the delete field will remove all corresponding data pertaining to the culvert that is deleted. The delete field is not used to retire a culvert.

**Yes** - Record will be deleted

**Retire Date** (*editable*) - Records the date a culvert was observed to no longer exist due to removal, filling, or replacement at the site. Populate this field to retire a culvert, which will remove it from the active Small Culvert Inventory and place it in a secondary inventory of retired features.

**PID** (*non-editable, automated*) - Unique numeric identifier auto generated through an overnight process.

**District** (*non-editable, automated*) - Identifies the district that maintains the culvert.

**Unit Name** (*non-editable, automated*) - Identifies the garage that maintains the culvert.

**Town** (*non-editable*) - Identifies the town that the culvert is located within.

**Twn\_MM** (*non-editable, automated*) – Town mile marker location for the culvert’s position on a state-maintained road.

**Route** (*non-editable, automated*) – The name of the state-maintained road on which the culvert is located.

**MS4** (*non-editable, automated*) - Records whether the culvert is within a Municipal Storm Water permitted area (MS4).

**Chittenden MS4** – Located in the Chittenden MS4 Region

**Rutland MS4** - Located within the Rutland MS4 Region

**St Albans MS4** – Located within the St Albans MS4 Region

**NO** – Culvert is not within the MS4 boundary

**Last Inspection Date** (*non-editable, automated*) - The date of the last inspection performed on culvert.

## **INLET OBSERVATIONS AND ASSESSMENTS continued:**

**Install Date** (*editable*) - The date the culvert was replaced or installed to its current specifications.

**Inlet Treatment** (*editable*) - Defines the inlet treatment of the culvert.

**No Treatment** - Default setting: culvert installed at grade.

**Drop Inlet** - Treatment includes grated and throated drop inlet or catch basin structures.

**Flared** - Concrete, metal, or plastic reinforcements attached to the culvert terminals to channel water, stabilize side slopes, and reduce scour and/or undercutting.

**Mitered** - Culvert is cut at an angle like the slope of the bank (base of the culvert inlet extends out past the top of the culvert inlet).

**Concrete Headwall** - Full height retaining wall at the end of culvert made of solid concrete.

**Stone Headwall** - Full height retaining wall at the end of the culvert made of stone material. Concrete rubble masonry is included in this category. Stones may be mortared or not.

**Concrete Cradled** - Half of a full concrete headwall on which the culvert inlet rests.

**Stone Cradled** - Half of a full Stone mortared / un-mortared headwall on which the culvert inlet rests.

**Junction Box** - An underground connection between culverts that is not associated with any of the other inlet treatments. Junction boxes do not have a surface feature capable of taking in water. For this inventory, all underground pipe intersections have been assumed to be junction boxes.

**Access Hole** - An access hole at the junction of two or more culverts, typically with a solid circular metal cover.

**Unknown** - The inlet was not located or could not be viewed or accessed.

**Other** - The inlet treatment is not included in the list of options. Record details in the "Inlet Comment" field.

## **INLET OBSERVATIONS AND ASSESSMENTS continued:**

**Inlet Tie-In** (*editable*) - Records the presence of a town or private system with a pipe of any size that extends into, influences, or discharges into our State network.

**Yes** - Observed private or town connections that outlet into the state system.

**No** – Default: no observed private or town tie in points.

**Unknown** - The inlet was not located or could not be viewed or accessed.

**Inlet Extension** (*editable*) - The culvert has a discernible extension

**Yes** - Observed culvert extension has been added to the culvert inlet

**No** - No discernable culvert extension at the culvert inlet

**Unknown** - The inlet was not located or could not be viewed or accessed.

**Inlet Marker Post** (*editable*) - Records the presence of a marker post at the culvert inlet. Only to be considered present if the post is 3' or greater in height to allow for visibility above moderate snow depth.

**Yes** – Default: observed marker post at the culvert inlet.

**No** - No observed functional marker post at the culvert inlet.

**Non-Applicable** -Marker Post is not appropriate or needed for the inspected culvert.

**Unknown** - The inlet was not located or could not be accessed.

## **INLET OBSERVATIONS AND ASSESSMENTS continued:**

**Inlet Separation** (*editable*) - Separation of individual pipe sections at joints or seams within the segment of pipe located between the inlet and pavement / gravel shoulder for cross culverts, or within first segment for lateral and slope culverts.

**None** - Default: no evidence of pipe separation. No gaps visible between sections or misalignment.

**Minor** - Visible separations less than 1" wide at isolated locations along the inlet. Slight misalignment of inlet sections visible.

**Moderate** - Significant separation less than 3" wide and not exceeding the bell of a concrete pipe. Misalignment visible throughout inlet.

**Major** - Separations greater than 3" wide throughout the inlet resulting in joint dislocation and possible sediment backfill and infiltration of water. Integrity of inlet is compromised due to misalignment.

**Unknown** - The inlet was not located or could not be viewed or accessed.

**Inlet Condition** (*editable*) - Records the condition of the culvert inlet, and inlet treatment.

**Good** - Inlet appears to be performing as designed without significant deficiencies.

**Fair** - Inlet possesses minor deficiencies, none of which significantly affect the performance of the inlet.

**Poor** - Inlet possesses significant deficiencies, resulting in a decreased efficiency.

**Critical** - Inlet is not performing as designed and is in immediate need of attention.

**Unknown** - The inlet was not located or could not be viewed or accessed.

## **INLET OBSERVATIONS AND ASSESSMENTS continued:**

**Inlet Sediment** (*editable*)- Records the level of sediment in culvert at the inlet end.

**None** - No sediment blocking culvert channel: clean culvert.

**Light** - Minor accumulation in the culvert without blocking the culvert channel. Less than 25% of total opening is filled.

**Moderate** - Culvert is 25-50% clogged with sediment, but the culvert channel is still capable of conveying water.

**Heavy** - Over 50% of the culvert opening full of sediment and is no longer functioning as intended.

**Plugged** - The sediment level in the culvert prevents the culvert from passing water.

**Unknown** - The inlet was not located or could not be viewed or accessed.

**Inlet Erosion** (*editable*) - Records the severity of erosion associated with a culvert in the area around the inlet.

**None** – Default: no evidence of erosion at culvert inlet.

**Light** - Soil is showing early signs of eroding away from culvert inlet.

**Moderate** - Clear signs of progressing erosion. Gaps and rills will become evident around culvert and/or culvert terminals.

**Severe** - Soil/gravel is severely eroded away from around the culvert and/or culvert terminals. The culvert is ceasing to function as intended, and water is beginning to travel its own course into and/or around the culvert.

**Unknown** - The inlet was not located or could not be viewed or accessed.

## **INLET OBSERVATIONS AND ASSESSMENTS continued:**

**Inlet Piping** (*editable*) - Records any evidence of water undermining the inlet of a culvert.

**Yes** - There is evidence of water running along the outside of the culvert rather than through the culvert.

**No** - There is no evidence of water running along the outside of the culvert rather than through the culvert.

**Unknown** - The inlet was not located or could not be viewed or accessed.

**Inlet Comment** (*editable*) - 230-character text field for any additional notes about the culvert's inlet.



## **BARREL OBSERVATIONS AND ASSESSMENTS:**

**Drain Type** (*editable*) - Records the classification of the drainage feature, based on the culvert orientation to the state roadway.

**Cross** - A culvert maintained by AOT that crosses under the roadway centerline. This does not include culverts within State ROW that cross under Town Highways and side-roads, Not parking lots or driveways)..

**Lateral** - A culvert maintained by AOT that runs parallel to the roadway and does not cross under the roadway, Town or State Highways, or private roads..

**Slope** - A culvert maintained by AOT extending from a drainage structure on the roadway shoulder that typically follows the slope of the embankment perpendicular to the road, and ultimately outlets near the toe of slope..

**Airport** - A culvert of any drainage type that is maintained by a State-owned airport.

**Park and Ride** - A culvert of any drainage type that is installed within a state-maintained park and ride facility.

**Rest Area** - A culvert of any drainage type that is located within a state-maintained rest area facility.

**Garage**- A culvert that passes under a means of access to a state-owned facility or compound. Please note that “garage” culverts are not “Private” culverts because they are maintained by the State of Vermont.

**Town** - A culvert that is owned by a local government or entity and is not maintained by AOT .

**Private** - A culvert that passes under a private driveway and is not maintained by the state but is within state ROW and or ditch line.

**Other** - Drainage type not covered under the preceding classifications.

## **BARREL OBSERVATIONS AND ASSESSMENTS continued:**

**System Type** (*editable*) - Records the type of drainage system classification based upon whether the culvert is independent or part of a dependent state-maintained system. System type is always determined by the outlet of a culvert.

**Single Pipe** – Culvert that is not attached to any other culverts: may have a Drop Inlet as an inlet treatment.

**Closed System** – Culvert that is connected to one or more additional culverts, but only if the end treatment is within an enclosed structure such as a Drop Inlet or Junction Box.

**Structure Type** (*editable*) - Records the specific culvert type, based upon shape.

**Round** - Pipe that has an opening that is circular in appearance.

**Box** - Pipe that has an opening that is square or rectangular in appearance.

**Squash** - A pipe with a designed width greater than the height.

**Arch** - A pipe with a height greater than the width and with bottom open.

**Other** - A pipe with a shape that does not match any of the given classifications within the small culvert inventory.

**Unknown** - Inspector is unable to identify the shape of a culvert opening.

## **BARREL OBSERVATIONS AND ASSESSMENTS continued:**

**Material** (*editable*) - Records the specific material of which the culvert is constructed.

**Stone** -A culvert that is hand laid with various sizes of stone: often found in older less established areas of roadway or towns.

**HDPE** – High Dynamic Poly Ethelene, a plastic material that is usually black in appearance: often found in culverts with a high degree of ground cover.

**PVC** - An alternative material to plastic used in the installation of culverts.

**Metal** - A metal culvert with undulating ribs found throughout its length.

**CONCRETE** - A culvert that is made of concrete and re-enforced rebar: this material is much less widely used in installations in modern day construction.

**OTHER** -The culvert is made of a material that does not fit into any of the established categories.

**Size** (*editable*) – Records the culvert diameter in inches.

**12"**

**15"**

**18"**

**24"**

**30"**

**36"**

**42"**

**48"**

**54"**

**60"**

**66"**

**72"**

**OTHER** - If the size is not available in the pre-selected list it can be entered as "OTHER" in this field, and the height and width values can then be added in the fields "Other Width" and "Other Height".

**UNKNOWN** - Inspector is unable to identify the size of a culverts opening.

## **BARREL OBSERVATIONS AND ASSESSMENTS continued:**

**Other Height** (*editable*) - Records the height of a culvert not defined by the above size categories. Recorded in inches.

**Other Width** (*editable*) - Records the width of a culvert not defined by the above size categories. Recorded in inches.

**Fill Depth** (*editable*) - Records the approximate depth of fill above the culvert. Depending on the Drain Type, depth of fill is estimated either at the roadway centerline, or culvert midpoint.

**Elbows** (*editable*) - Records the presence of one or more angle connections in a culvert length.

**YES** - One or more elbow(s) are present.

**NO** - No elbow observed.

**Unknown** - Some or all the culvert interior could not be viewed.

**Modifications** (*editable*) - Records any modifications or repair work that has been done to the inside of a culvert.

**None** - Default field, no modifications have been made to the culvert.

**Cured in Place Lining** - A cured in place liner has been installed within the existing culvert.

**Sleeve** - A culvert sleeve has been inserted into the existing culvert.

**Asphalt Coated** - The barrel of a culvert shows evidence of an asphalt coating: typically found on CGMP culverts, usually visible as a thin coating of asphalt running along the length of the culvert.

**Plastic Coated** - The culvert shows evidence of a thin plastic coating: typically found on CGMP culverts.

**Other** - Other modification not covered in the above list. Record details in the "General Comment" field.

**Unknown** – Inspector is unable to identify the type of Modification or access to culvert is unavailable

## **BARREL OBSERVATIONS AND ASSESSMENTS continued:**

**Barrel Separation** (*editable*) - Separation of individual pipe sections at joints or seams.

**None** – Default: no evidence of pipe separation. No detectable gaps between sections, and no misalignment visible.

**Minor** - Minor separations less than 3” wide at isolated locations along the culvert. Slight misalignment of culvert sections visible.

**Moderate** - Significant separation less than 3” wide and separation greater than 3” at outlet or inlet end section. Misalignment visible throughout culvert.

**Major** - Separations greater than 3” wide throughout the culvert resulting in joint dislocation and possible sediment backfill and infiltration of water. Integrity of culvert is compromised due to misalignment.

**Unknown** - Culvert barrel was not accessible for assessment.

**Barrel Condition** (*editable*) - Records the overall condition of the culvert barrel. See Appendix A, B, and C for detailed descriptions.

**Good** -

**Fair** -

**Poor** -

**Critical** -

**Unknown** - Culvert barrel was not accessible for assessment.

## **BARREL OBSERVATIONS AND ASSESSMENTS continued:**

**Barrel Sediment** (*editable*) - Records the level of sediment within culvert barrel.

**None** - No sediment blocking culvert channel: clean culvert.

**Light** - Minor accumulation in the culvert without blocking culvert channel. Less than 25% of total opening is filled.

**Moderate** - Culvert is 25-50% clogged with sediment. The culvert channel is still capable of conveying water.

**Heavy** - Over 50% of the culvert opening full of sediment and is no longer functioning as intended.

**Plugged** - The sediment level in the culvert prevents the culvert from completely passing water.

**Unknown** - Culvert barrel was not accessible for assessment.

**Barrel Comment** (*editable*) - 230-character text field for any additional notes about the culvert barrel.

## **OUTLET OBSERVATIONS AND ASSESSMENTS:**

**Outlet Treatment** (*editable*) - Defines the outlet treatment of the culvert.

**No Treatment** – Default: culvert installed at grade.

**Drop Inlet** - Includes grated and throated drop inlets, and catch basin structures.

**Flared** - Concrete, metal, or plastic reinforcements attached to the culvert terminals to channel water, stabilize side slopes, and reduce scour and/or undercutting.

**Mitered** - Culvert is cut at an angle like the slope of the bank: the base of the culvert outlet extends out past the top of the culvert outlet.

**Concrete Headwall** - Full height retaining wall at the end of culvert made of solid concrete.

**Stone Headwall** - Full height retaining wall at the end of culvert made of stone material. Concrete rubble masonry is included in this category. Stones may or may not be mortared.

**Concrete Cradled** - Half of a full concrete headwall on which the culvert outlet rests.

**Stone Cradled** - Half of a full mortared / un-mortared Stone headwall on which the culvert outlet rests.

**Junction Box** - An underground connection between culverts that is not associated with any of the other inlet treatments. Junction boxes do not have a surface feature capable of taking in surface water. For this inventory, all underground pipe intersections have been assumed to be junction boxes. Be advised that all junction boxes are topped with a square concrete cover.

**Access Hole** - An access hole at the junction of two or more culverts, typically with a solid circular metal cover.

**Other** - The outlet treatment is not included in the list of options. Record details in the “Outlet Comment” field.

**Unknown** - Culvert outlet was not accessible for assessment.

## **OUTLET OBSERVATIONS AND ASSESSMENTS continued:**

**Outlet Tie-In** (*editable*) - Records the presence of a town or private system with a pipe of any size that extends into, influences, or discharges into our State network.

**Yes** - Observed private or town connection out-letting from state system into other closed system.

**No** - Default, no observed private or town tie-in points.

**Unknown** - Culvert outlet was not accessible for assessment.

**Outlet Marker Post** (*editable*) - Records the presence of a marker post at the culvert outlet. Only to be considered present if the post is 3' or greater allowing visibility above moderate snow depth. .

**Yes** – Default: observed marker post at the culvert outlet.

**No** - No observed functional marker post at the culvert outlet.

**Non-Applicable** - Marker Post is not appropriate or needed for the inspected culvert.

**Unknown** - Culvert outlet was not accessible for assessment.



## **OUTLET OBSERVATIONS AND ASSESSMENTS continued:**

**Outlet Separation** (*editable*) - Separation of individual pipe sections at joints or seams within segment of pipe between outlet and pavement / gravel shoulder for cross culverts, or within first segment for lateral and slope culverts.

**None** – Default: no evidence of pipe separation. No detectable gaps between sections or visible misalignment.

**Minor** - Visible separations less than 1”-wide at isolated locations along the outlet: slight misalignment of outlet sections visible.

**Moderate** - Significant separation less than 3” wide and not exceeding the bell of a concrete pipe: misalignment visible throughout outlet.

**Major** - Separations greater than 3” wide throughout the outlet resulting in joint dislocation and possible sediment backfill and infiltration of water: integrity of outlet is compromised due to misalignment.

**Unknown** - Culvert outlet was not accessible for assessment.

**Outlet Condition** (*editable*) - Records the condition of the culvert outlet and outlet treatment.

**Good** - Outlet appears to be performing as designed: deficiencies are superficial.

**Fair** - Outlet possesses minor deficiencies, none of which significantly affect the performance of the outlet.

**Poor** - Outlet possesses significant deficiencies, resulting in a decrease in efficiency.

**Critical** - Outlet is not performing as designed and is in immediate need of attention.

**Unknown** - Culvert outlet was not accessible for assessment.

## **OUTLET OBSERVATIONS AND ASSESSMENTS continued:**

**Outlet Sediment** (*editable*) - Records the level of sediment in the culvert at the outlet end.

**None** - No sediment blocking culvert channel: clean culvert.

**Light** - Minor accumulation in the culvert without blocking culvert channel. Less than 25% of total opening is filled

**Moderate** - Culvert is 25-50% clogged with sediment. The culvert channel is still capable of conveying water.

**Heavy** - Over 50% of the culvert opening full of sediment and is no longer functioning as intended.

**Plugged** - The sediment level in the culvert prevents the culvert from passing water.

**Unknown** - Culvert outlet was not accessible for assessment.

**Outlet Erosion** (*editable*) - Records the severity of erosion associated with a culvert in the area around the outlet.

**None** – Default: no evidence of erosion at culvert outlet.

**Light** - Soil is showing early signs of eroding away from culvert outlet.

**Moderate** - Clear signs of progressing erosion. Gaps and rills will become evident around culvert and/or culvert terminals.

**Severe** - Soil/gravel is severely eroded away from around the culvert and/or culvert terminals. Culvert is ceasing to function as intended and water is beginning to travel its own course out of and/or around the culvert.

**Unknown** - The outlet was not located, or could not be viewed or accessed, and therefore was not assessed.

## **OUTLET OBSERVATIONS AND ASSESSMENTS continued:**

**Outlet Piping** (*editable*) - Records any evidence of water undermining the outlet of a culvert.

**Yes** - There is evidence of water running along the outside of the culvert rather than through the culvert.

**No** - There is no evidence of water running along the outside of the culvert rather than through the culvert.

**Unknown** - Culvert outlet was not accessible for assessment.

**Outlet Comment** (*editable*) - 230-character text field for any additional notes.

**Projected End** (*editable*) - Culvert end extends out from embankment causing exit water to drop one foot or greater, creating conditions conducive to scour holes.

**Yes** - There is a projecting end at outlet.

**No** - No projected end at outlet.

**Unknown** - Culvert outlet was not accessible for assessment.

**Stone Pad** (*editable*) - Records the presence of a substantially sized flat stone area, either natural or constructed, dispersing the energy of falling water to prevent scouring.

**Yes** - Adequate stone pad present at outlet.

**No** - Stone pad is not present at outlet and no protection from scouring is present, though protection is needed.

**Non-Applicable** -A stone pad is not needed to control the fall of water for the inspected culvert.

**Unknown** - Culvert outlet was not accessible for assessment.

## **OUTLET OBSERVATIONS AND ASSESSMENTS continued:**

**Road Settle** (*editable*) - Records whether there is roadway settling present at culvert location.

**None** – Default: no roadway settlement observed.

**Repair** - Location shows evidence of repair, and or recent paving..

**Grade Change** - Location shows visible grade change, or roadway settlement. May still display evidence of repair.

**Sink Holes** (*editable*) - Records whether sinkholes or areas of settlement are present on the roadway embankment slopes.

**None** - No sinkholes were observed.

**Minor** - Sinkholes less than 3' in diameter and/or sinkholes located more than 15' from the edge of pavement.

**Moderate** - Sinkholes between 3-5' in diameter, and/or sinkholes located less than 15' from the edge of pavement.

**Major** - Sinkholes greater than 5' in diameter and/or sinkholes that are located less than 10' from the edge of pavement.

**Severe** - Sinkholes of any diameter that are within the pavement area.

**Unknown** - Evidence of void influenced erosion is present near the culvert, but no visual evidence of sink holes can be found or seen.

**General Comment** (*editable*) - 230-character text field for any additional notes about the outlet.

## **OUTLET OBSERVATIONS AND ASSESSMENTS continued:**

**Structural Rating** (*editable*) - Used as an overall score to monitor the status of a culvert's structural integrity. This field can be used to flag culverts that need to be monitored for structural issues.

**No Action Needed (GREEN)** - Culvert is structurally sound and does not require monitoring.

**Monitoring Needed (YELLOW)** - Culvert is showing signs of structural deterioration. Asset requires further monitoring to ensure the structural failure does not occur.

**Action Needed (RED)** - Culvert is no longer structurally sound: one or multiple areas of the structure are failing. Culvert requires immediate action to prevent catastrophic failure.

**Functional Rating** (*editable*) - Used as an overall score to monitor the functional efficiency of a culvert. This field may be used to flag culverts that need to be monitored for functional issues.

**No Action Needed (GREEN)** - Culvert is structurally sound and does not require monitoring.

**Monitoring Needed (YELLOW)** - Culvert is showing signs of functional issues. Asset requires further monitoring to ensure that proper functioning is ensured.

**Action Needed (RED)** - Culvert is no longer functioning as intended: one or multiple parts of the culvert functionality are compromised. Culvert requires immediate action to prevent catastrophic failure.

**Functional Status** (*editable*) - Records a permanent change in the functionality of culverts due to an alteration to its original design and identifies culverts that are out of tolerance by AOT Policy.

**Abandoned** - Culvert has been intentionally un-maintained. A change in the ditching or drainage design within the area has rendered it obsolete

**Discontinued** - Culvert has intentionally been plugged with a foreign material or object to cease its ability to accept drainage

**Filled** - Culvert has been purposefully filled, but not removed. Fill substances such as flowable fill or concrete are used to render the asset no longer functioning.

**OUTLET OBSERVATIONS AND ASSESSMENTS continued:**

**Inspector** (*editable*) - Identifies the culvert inspector.

**Inspection Date** (*editable*) - Records the date of the culvert inspection.

## **DROP INLET (DI) OBSERVATIONS AND ASSESSMENTS:**

**Delete Record** (*editable*) - Allows the user to delete an accidentally added DI. The delete field is not used to retire a DI. Using the delete field will remove all corresponding data pertaining to the DI..

**Yes** - Record will be deleted and all corresponding data pertaining to the DI will be removed.

**Retire Date** (*editable*) - Records the date DI was observed to be absent due to removal, filling, or replacement at the site.

**District** (*non-editable, automated*) - Identifies the district that maintains the DI.

**Unit Name** (*non-editable, automated*) - Identifies the garage that maintains the DI.

**Town** (*non-editable*) - Identifies the town in which the DI is located.

**Twn\_MM** (*non-editable, automated*) - Town mile marker location for the DI's position on a state-maintained road.

**Route** (*non-editable, automated*) – The name of the state-maintained roadway on which the DI is located.

**MS4** (*non-editable, automated*) - Records whether the culvert is within a Municipal Storm Water permitted area (MS4).

**Chittenden MS4**

**Rutland MS4**

**St Albans MS4**

**Last Inspection Date** (*non-editable, automated*) - The date of the last inspection performed on the DI.

**Install Date** (*editable*) - The date that the DI was replaced or installed to its current specifications.

## **DROP INLET (DI) OBSERVATIONS AND ASSESSMENTS continued:**

**Responsibility** (*editable*) - Records which governing body is responsible for maintaining a culvert.

**Private** - Culvert is maintained by a non-local or state government, (private company or resident).

**Town** - Culvert is owned and maintained by a municipal governing body.

**State** - Culvert is part of the State maintained network of small culverts.

**Unknown** – Unable to identify the governing body responsible for maintenance of the asset.

**DI Type** (*editable*) - Identifies the type of DI structure present.

**Drop Inlet** - Vertical structure connected to a horizontal pipe that allows the intake of surface water.

**Stand Pipe [SP]** – DI consisting of a vertical pipe with a grate that connects into the top of a horizontal culvert.

**Junction Box** - Connection structure between two or more pipes that does not allow for the intake of surface water. The structure may be buried or above ground.

**Dry Sump** - Type of DI that has no pipes connected to a drainage structure and allows captured surface water to percolate into ground through a sand bottom.

**Unknown** – There is evidence that a DI is installed at present location, yet the type of DI is not identifiable due lack of visual confirmation.



## **DROP INLET (DI) OBSERVATIONS AND ASSESSMENTS continued:**

**Grate Type** (*editable*) - Describes the material and design of the grate covering the DI structure. Letters “A – E” refer to grate type taken from our Vermont State Standards for DI grates.

**Grate Type Key: See Appendix D for Detailed Drawings.**

**Half B** - Grate exhibits the characteristics of the B grate but is half the dimensions. Common on bridges and bridge approaches.

**Steel Grate** - Grate made of steel matching or like the design shown on the Grate Type Key.

**Throated** - DI without a grate cover in which concrete slabs accept drainage flow through the sides of the DI.

**Other** - Any grate type not falling into one of the classifications listed above.

**Unknown** - The DI was not accessible for assessment.

**No Grate** - No grate is present on the top of the DI.

**Number of Grates** (*editable*) - Number of metal grates on DI structure. Default is 1 grate. DO NOT include concrete slabs of throated DIs or junction boxes.

**Condition** (*editable*) - Records the condition of the DI including grate, cement collar connection to pipes, and other parts of the structure.

**Good** - DI appears to be performing as designed: deficiencies are superficial.

**Fair** - DI possesses minor deficiencies, none of which significantly affect the performance of the outlet. Minor cracks or spalling are visible.

**Poor** - DI possesses significant deficiencies, which result in a decrease in efficiency. Collar infiltration is present.

**Critical** - The DI is not performing as designed and is in immediate need of attention. Water entering through DI. Substantial spalling of concrete.

**Unknown** - The DI was not accessible for assessment.

## **DROP INLET (DI) OBSERVATIONS AND ASSESSMENTS continued:**

**Condition Comment** (*editable*) - 230-Character text field for any additional notes regarding condition.

**Brick Collar** (*editable*) - Records the condition of the brick collar noting if the bricks are securely in place, becoming loose, spalling; and if spalling of bricks and / or mortar are present.

**None** - No brick collar is present.

**Good** - Brick collar and mortar are intact and working as designed.

**Fair** - Brick collar is starting to deteriorate. Bricks still intact with possible missing mortar between bricks. Deficiencies do not significantly affect the performance of the DI.

**Poor** - Brick collar possesses significant loss of mortar and minor loss of bricks. Bricks visible in sump. DI still functioning with minor decrease in efficiency.

**Critical** - Brick collar shows signs of extensive brick and mortar deterioration. Evidence of water draining through collar instead of top grate. The DI needs immediate attention.

**Unknown** - The DI was not accessible for assessment.

**Sediment** (*editable*) - Records the level of sediment in the bottom of the DI, gauging from the sediment levels in the culvert opening(s).

**None** - No sediment blocking water flow through the DI vault. No sediment present in culvert(s).

**Light** - Minor accumulation in the culvert(s) without blocking water flow through the DI vault. Less than 25% of total culvert opening(s) are filled.

**Moderate** - Culvert(s) are 25-50% clogged with sediment. The DI vault is still capable of conveying water through the culvert opening(s) within.

**Heavy** - Over 50% of the culvert opening(s) are full of sediment and the DI vault is no longer functioning as intended.

**Plugged** - The sediment level in the DI vault prevents the culvert opening(s) from passing water.

## **DROP INLET (DI) OBSERVATIONS AND ASSESSMENTS continued:**

**Unknown** - The DI was not accessible for assessment.

**Erosion** (*editable*) - Records the severity of erosion near cement collar of a DI.

**None** - Default: no evidence of erosion at DI.

**Light** - Soil is showing early signs of eroding away from DI collar.

**Moderate** - Clear signs of progressing erosion. Gaps and rills will become evident around DI on one or more sides.

**Severe** - Soil/gravel is severely eroded away around the DI. Drainage is not functioning as intended. Water is beginning to travel its own course into and/or around the DI.

**Unknown** - The DI was not accessible for assessment.

**Collar Infiltration** (*editable*) - Records evidence of drainage waters entering the DI through means other than the surface grate.

**Yes** - There is evidence of water entering the DI in areas not designed to take drainage.

**No** - There is no evidence of water entering the DI through non-designed entries.

**Unknown** - The DI was not accessible for assessment.

**General Comment** (*editable*) - 230-Character text field for any additional notes regarding DI condition.

## **DROP INLET (DI) OBSERVATIONS AND ASSESSMENTS continued:**

**Functional Status** (*editable*) - Records a permanent change in the functionality of culverts due to an alteration to its original design, and identifies culverts that are out of tolerance by AOT Policy.

**Abandoned** - DI has been intentionally un-maintained due to a change in the ditching or drainage design within the area rendering it obsolete. DI is no longer functioning but has not been removed.

**Discontinued** - DI has intentionally been plugged with a foreign material or object to cease its ability to accept drainage but DI has not been removed.

**Filled** – DI has been purposefully filled but not removed. Fill substances such as flowable fill or concrete have been used to render the asset as no longer functioning.

**Inspector** (*editable*) - Identifies the culvert inspector initials.

**Inspection Date** (*editable*) - Records the date of culvert inspection.

## **ACCESS HOLE (AH) OBSERVATIONS AND ASSESSMENTS:**

**Delete Record** - Allows the user to delete an accidentally added Access Hole (AH). The delete field is not used to retire an AH. Using the delete field will remove all corresponding data pertaining to the AH that is deleted.

**Yes** - Record will be deleted and all corresponding data pertaining to the AH will be removed.

**Retire Date** (*editable*) - Records the date AH was observed to be absent due to removal, filling, or replacement at the site.

**District** (*non-editable, automated*) - Identifies the district that maintains the AH.

**Unit Name** (*non-editable, automated*) Identifies the garage that maintains the AH.

**Town** (*non-editable*) - Identifies the town in which the AH is located.

**Twn\_MM** (*non-editable, automated*) - Town mile marker location of the AH position on a state-maintained road.

**Route** (*non-editable, automated*) - the name of the state-maintained road on which the AH is located.

**Install Date** - The date the AH was replaced or installed to its current specifications

**Responsibility** (*editable*) - Records which governing body is responsible for maintaining a culvert.

**Private** - Culvert is maintained by a non-local or state government, (private company or resident).

**Town** - Culvert is owned and maintained by a municipal governing body.

**State** - Culvert is part of the State maintained network of small culverts.

**Unknown** – Unable to identify the governing body responsible for maintenance of the asset.

**Cover Text** (*editable*) - 30-character text field for recording the labeling on top of AH cover, if legible.

## **ACCESS HOLE (AH) OBSERVATIONS AND ASSESSMENTS continued:**

**General Comment** (*editable*) - 230-character text field for entering any additional notes regarding the AH condition.

**Functional Status** (*editable*) - Record a permanent change in the functionality of culverts due to an alteration to its original design, and identifies culverts that are out of tolerance by AOT Policy.

**Abandoned** - AH has been intentionally un-maintained due to a change in the ditching or drainage design within the area rendering it obsolete. AH is no longer functioning, but has not been removed.

**Discontinued** - AH has intentionally been plugged with a foreign material or object to cease its ability to accept drainage but the AH has not been removed

**Filled** – AH has been purposefully filled but not removed. Fill substances such as flowable fill or concrete have rendered the asset no longer functioning.

**Inspector** (*editable*) - Identifies the culvert inspector.

**Inspection Date** (*editable*) - Records the date of culvert inspection.

## SMALL CULVERT INVENTORY CLARIFICATIONS

### Large Culverts and Small Culverts

The Small Culvert Inventory (SCI) program has been developed for State Ultra Short structures (< or = 6'). Another program under the VTrans Structures Section maintains a National Bridge Inventory System (NBIS) and inspects State and Town Long Structures (> or = 20') and State Short Structures ( $\leq 20'$  >= 6'). Using this logic, all structures should be included within one of these two programs. An exception to this logic is raised because of a difference in the definition of structure size measurement.

The VTrans structures section uses definitions developed by the Federal Highway Administration that are designed primarily for bridge inspection. Under this definition, the bridge and culvert span is a measurement from interior wall to interior wall.

The SCI has been designed to inventory culverts, and therefore records a design diameter. This leaves a possibility that culverts designed at a diameter of 72" may have a span that has an internal dimension greater than or equal to 72" after installation. This has previously resulted in culverts being excluded from both the SCI and NBIS.

To ensure that there are no culverts that fall between these two inventories, the SCI will contain all culverts with a diameter less than or equal to 72". The post-processed data will be compared to the existing NBIS, using the NBIS GIS data layer. All culverts with a diameter of greater than 72" not in that database will be provided to the Structures Section for inclusion into the NBIS.

Though this procedure might seem redundant, the benefits greatly outweigh the associated time and cost. During the first year of collection, over 2700 culverts were collected, though only 17 of these culverts had a size of 72". Of those 17 culverts, 15 were redundant to the NBIS inventory. This redundancy could be corrected.

### Bridge Plaques on Ultra Shorts

In some cases, Ultra Short culverts have been assigned bridge plaques to aid in the district inspection of culverts of 4'-6'. Presence of a bridge plaque does not mean it is contained in the bridge or culvert inventory. The structure should be inventoried for the SCI if the diameter is less than or equal to 6' / 72". Additionally, the bridge plaque information should be added in the "General Comment" field.

## Drainage Systems and State Right of Way

ROW drainage systems are complex systems that do not adhere to the bounds of State Right of Way; parcel boundaries; or the separation of state, municipal, and private drainage in a convenient manner. When following a drainage outflow, the rule is to follow the system one pipe-end beyond the State ROW.

Thus, if a pipe system ends inside the state ROW, but another inlet or outlet is located near the state system, the additional culvert should be inspected and added to the SCI. This will be a non-state-maintained culvert with a Drain Type of “Town” or “Private”. This rule also applies to pipes that outlet into the state drainage system. To properly collect these culverts, follow the non-state pipe from the state system out to the inlet-end and record the inlet location.

In both cases, when taking the location of the most remote inlet or outlet, assign the tie-in point field as “Yes”. This will indicate that the tie-in locations are not the true end or beginning of the state drainage system.

## Non-existent, Discontinued, Retiring and Replacing Culverts

When conducting culvert re-inspections, there may be situations in which the previous inspection data seems illogical or contradictory to the state of the culvert being inspected. In some cases, the previous inspection may be listing data from a culvert that is no longer present at the location, or from a culvert that has been intentionally discontinued and is no longer functional. If a new culvert has been installed, you will need to first retire the old culvert, and then create a new feature to collect the inspection data for the newly installed culvert.

Below are examples of potential situations and the proper procedures to follow:

**1. Discontinued** - A culvert that has intentionally been plugged or covered at the inlet and outlet by fill, pavement, or foreign objects to arrest the functionality of the culvert and eliminate the ability for water to enter or exit the culvert.

### Procedure:

1. Select the culvert to discontinue and begin editing.
2. Update the “Functional Change” field to “Discontinued”.
3. Update the “Inspection Date” field to the current date.
4. Click “Done” within the edit window and select “Update” to grey out the feature on the map.



## Non-existent, Discontinued, Retiring and Replacing Culverts continued

**2. Retiring** - A culvert that has signs of recent installation and has replaced the existing culvert shown within the **SCI app**. This is especially relevant if the material and size values do not match those of the culvert being inspected in the field.

### Procedure:

1. Select the culvert you want to retire and begin editing the feature.
2. Update only the "RETIRE DATE" to the current date, select "Done", and then "Update" to grey out that feature on the map.
3. Create a new feature in the location of the new culvert and populate all necessary fields. The "INSPECTION DATE" field will need to be updated.

**3. Replacement** – The value "New Install" is used when you have retired an existing culvert and created a new feature in its place. Within the new feature populate the "New Install" field with "Replacement" to identify the type of install that was performed.

### **New Construction Culvert Installations.**

Newly constructed drainage infrastructure or networks that are not replacing or upgrading existing infrastructure may be new culverts installed due to roadway reconstruction, redesign, or to improve drainage within the area.

Below is the procedure for inputting new construction culverts installations:

1. Using the ESRI Collector App with a mobile device, create a new feature in the location of the newly constructed culvert or drainage network. This may require creation of new Drop Inlet, Junction Box, or Access Hole features based on the system type installed.
2. Verify and complete every field within the attribute window.
3. Within the "New Install" field, select "NEW CONSTRUCTION". This will allow the Agency of Transportation to revisit these locations and improve the spatial accuracy of the data collected in the field.

**For questions regarding the Small Culvert Inventory Field Manual or SCI field collection please contact:**

**Alex Nicholson** [alexander.nicholson@vermont.gov](mailto:alexander.nicholson@vermont.gov) (802-424-6030).

**For questions regarding about Small Culvert Inventory data structure and databases please contact:**

**Dan Schall** [David.Narkewicz@vermont.gov](mailto:David.Narkewicz@vermont.gov) (802-279-8304).

## Appendix A:

**Metal Culvert Condition Ratings:** The following lists potential culvert characteristics that may result in a “Good”, “Fair”, “Poor”, or “Critical” culvert condition.

### Good Condition:

- No appreciable settlement or misalignment observed
- Horizontal diameter within 0-10% of design
- Superficial rust, corrosion, or staining observed
- Minor isolated distortions
- Minor isolated cracking at bolts
- Tight fitting joints

### Fair Condition:

- Minor settlement or misalignment observed
- Significant distortion observed in isolated location
- Horizontal diameter within 10-20% of design
- Spotty heavy rust and corrosion
- Minor pitting present
- Noticeable non-symmetric shape
- Minor separation of joints and seams
- Evidence of minor sediment deposits

### Poor Condition:

- Significant settlement or misalignment observed
- Horizontal diameter within 20-30% of design
- Perforations, severe corrosion, and moderate pitting present
- Moderate non-symmetric shape
- Evidence of significant material deposits
- Evidence of infiltration or exfiltration of water or sediment due to joint separation

### Critical Condition:

- Culvert has collapsed, or a collapse is imminent
- Major settlement or misalignment observed

## **Appendix A CONTINUED:**

### **Critical Condition:**

- Major distortion observed
- Horizontal diameter greater than 30% of design
- Severe perforations, corrosion, and pitting present
- Extreme non-symmetric shape
- Structural cracks observed throughout culvert
- Evidence of major material deposits
- Major joint separations

## Appendix B:

**Plastic (HDPE) Culvert Condition Ratings:** The following lists potential culvert characteristics that may result in a “Good”, “Fair”, “Poor”, or “Critical” culvert condition.

### Good Condition:

- No, or no appreciable settlement or misalignment observed
- Minor distortion
- Horizontal diameter within 0-20% of design
- Relatively smooth wall, minor deflection
- No separations

### Fair Condition:

- Minor settlement or misalignment observed
- Horizontal diameter within 20-35% of design
- Minor dimpling in isolated, small areas
- Moderate deflection observed, resulting in non-symmetric shape
- Minor separation at joints
- Minor isolated perforations
- Evidence of minor material deposits

### Poor Condition:

- Significant settlement or misalignment observed
- Horizontal diameter greater than 35% of design
- Wall crushing, tearing, or cracking observed
- Significant deflection, resulting in extreme non-symmetric shape
- Evidence of significant material deposits
- Evidence of infiltration or exfiltration of water or sediment due to joint separations

## **Appendix B CONTINUED:**

### **Critical Condition:**

- Major settlement or misalignment observed
- Collapse of culvert crown
- Major wall crushing, tearing, or cracking observed
- Major deflection, extreme non-symmetric shape
- Significant perforations
- Major material deposits
- Infiltration or exfiltration of water or sediment due to joint separations
- Culvert has collapsed, or a collapse is imminent

## Appendix C:

**Concrete Culvert Condition Ratings:** The following lists potential culvert characteristics that may result in a “Good”, “Fair”, “Poor”, or “Critical” culvert condition.

### Good Condition:

- No, or no appreciable settlement or misalignment observed
- Shallow mortar deterioration observed at isolated locations
- Hairline cracking present, less than 1/16” of an inch

### Fair Condition:

- Minor settlement or misalignment observed
- Minor joint separation
- Mortar loose or missing, spalling at isolated locations
- Evidence of minor material deposits
- Horizontal cracking present, less than 1/8” of an inch

### Poor Condition:

- Significant settlement or misalignment observed
- Significant openings or dislocated joints
- Extensive areas of missing mortar, spalling
- Evidence of significant material deposits
- Evidence of infiltration or exfiltration of water or sediment at joints
- Significant horizontal and diagonal cracking present
- Cracking less than ½”

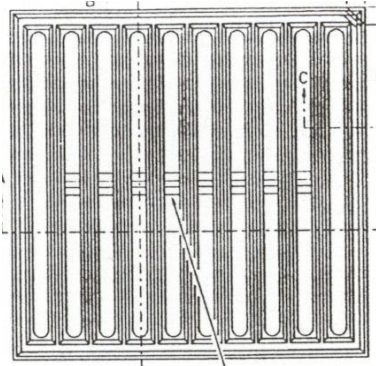
Rebar may be exposed

### Critical Condition:

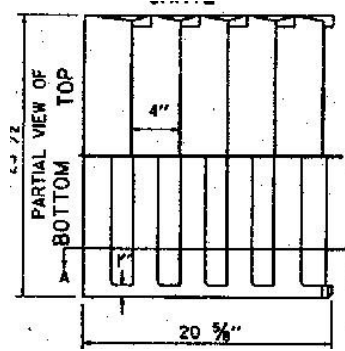
- Culvert has collapsed, or a collapse is imminent
- Major settlement or misalignment observed
- Significant dislocated joints
- Widespread areas of missing mortar and or spalling.
- Major material deposits
- Significant horizontal and diagonal cracking present
- Multiple large cracks greater than ½”
  - Deterioration causing rebar to become exposed

**Appendix D:**

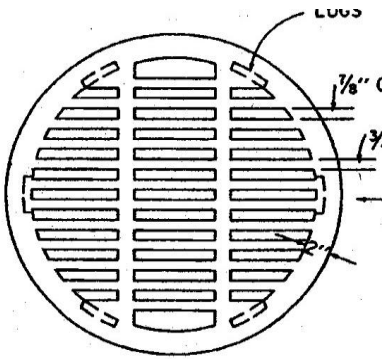
**DI Grate Type Key:**



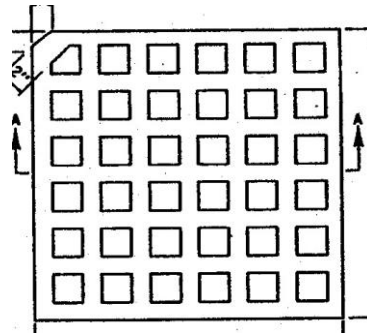
Grate Type A.



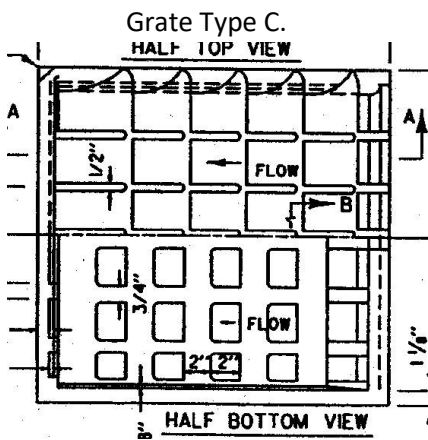
Grate Type B.



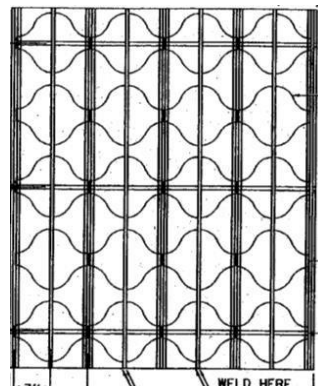
Grate Type C.



Grate Type D.



Grate Type E.



Steel Grate